

Working in Cold Environments

With the arrival of winter, outdoor workers face an additional occupational hazard—exposure to the cold. Prolonged exposure to freezing temperatures can result in health problems as serious as trench foot, frostbite, and hypothermia. Each year in the United States, more than 700 people die of hypothermia. Workers in such industries as construction, commercial fishing and agriculture need to be especially mindful of the weather, its effects on the body, proper prevention techniques, and treatment of cold-related disorders.

The body tries to maintain an internal (core) temperature of approximately 37°C (98.6°F). An individual gains body heat from food and muscular activity and loses it through convection, conduction, radiation, and sweating to maintain a constant body temperature. When the body temperature drops even a few degrees below its normal temperature, the body's first response is constriction of the blood vessels of the skin, which reduces heat loss from the surface of the skin by decreasing peripheral blood flow; shivering can generate heat by increasing the body's metabolic rate.

There are four environmental conditions that cause cold-related stress: low temperatures, high/cool winds, dampness, and cold water. Wind-chill involves the combined effect of air temperature and air movement. The higher the wind speed is and the lower the temperature in the work environment is, the greater the insulation value of the protective clothing which is necessary to prevent cold exposure injuries. Unprotected skin will freeze at temperatures below -1°C (30.2°); however, wind-chill can be a significant factor in accelerating the process. **When air speed and temperature produce a wind-chill of -32°C (-25.6°F), continuous skin exposure should not be permitted.** If wind speed is not available, the following signs may help to estimate wind speeds in the field:

- 5 mph (8 km/hr) light flag just moves
- 10 mph (16 km/hr) light flag is fully extended by the wind
- 15 mph (24 km/hr) raises a newspaper sheet off the ground
- 20 mph (32 km/hr) wind capable of blowing snow.

In addition to the cold environment, other major risk factors contributing to cold-related stresses include:

- Inadequate clothing or wet clothing
- Drug use or certain medications may inhibit the body's response to cold or impair judgment
- A cold or other disease, such as diabetes, atherosclerosis, and hypothyroidism, may increase risk
- Gender: male death rates due to cold exposure are greater than the rates for females; perhaps because of inherent risk-taking activities, body fat composition, or other physiological differences
- Susceptibility increases with age
- Exhaustion or immobilization, especially through injury or entrapment.

Harmful Effects of Cold Exposure

Common harmful effects of cold exposure include frostbite, trench foot, and general hypothermia.

Frostbite occurs when skin tissue actually freezes and cell damage results. Fingers, toes, cheeks, nose, and ears are primarily affected. The symptoms of frostbite include an uncomfortable sensation of coldness; there may be a tingling, stinging, or aching feeling followed by numbness. Initially the frostbitten area appears white and is cold to the touch. This is followed by heat, redness, and swelling. Occasionally, a victim may not be aware of the frostbite.

Tissue damage can be mild and reversible or severe, resulting in scarring and tissue death. Amputation or loss of function can be an unfortunate result. If you suspect frostbite, you should seek medical assistance immediately. First aid includes treating affected areas with warm water at 102°–110°F. Be careful to avoid rubbing frostbitten areas because this can lead to greater tissue injury. If there is a chance for refreezing, do not rewarm the affected areas.

Trench foot may be caused by long, continuous exposure to a wet and cold environment, or actual immersion in water. This may be a special concern of commercial fishermen. The condition is characterized by vascular damage. Symptoms include a tingling and/or itching sensation, pain, and swelling. Blisters may form and be followed by death of skin tissue and ulceration.

First aid treatment for trench foot is similar to the treatment for frostbite, and includes: moving the victim to a warm area; treating the affected part with warm water (102°–110°F) or warm packs; arranging bed rest in a warm environment; and obtaining medical assistance as soon as possible.

General hypothermia is the progressive loss of body heat with prolonged exposure to cold. Body heat loss is accelerated more rapidly when a person is wet because of sweat or working in a damp environment. While hypothermia is generally associated with freezing temperatures, it may occur in any climate where a person's body temperature falls below normal. Most cases of hypothermia develop in air temperatures between 30°–50°F (particularly when clothing is wet), or in the water at 72°F.

The first symptoms of hypothermia, shivering, an inability to do complex motor functions, lethargy, and mild confusion, occur as the core body temperature decreases to around 95°F. As body temperature continues to fall, hypothermia becomes more severe. The individual falls into a state of dazed consciousness, failing to complete even simple motor functions. The victim's speech becomes slurred and their behavior may become irrational. The most severe state of hypothermia occurs when body temperature falls below 90°F. As a result, the body moves into a state of hibernation, slowing the heart rate, blood flow, and breathing. Unconsciousness and full heart failure can occur in the severely hypothermic state. When the core body temperature falls below 86°F, the

body's adaptive mechanisms for reducing heat loss become ineffective and death can occur.

Treatment of hypothermia involves conserving the victim's remaining body heat and providing additional heat sources. Specific measures will vary depending upon the severity and setting (field or hospital). Handle hypothermic victims very carefully because of the increased irritability of the cold heart; sudden movements can trigger abnormal and dangerous heart rhythms. Seek medical assistance as soon as possible for persons suspected of being moderately or severely hypothermic. If the person is unresponsive and not shivering, assume he or she is suffering from severe hypothermia. Reduction of heat loss can be accomplished by various means: obtaining shelter, removal of wet clothing, adding layers of dry clothing, blankets, or using a pre-warmed sleeping bag. External warming techniques include body-to-body contact (e.g., placing the victim in a pre-warmed sleeping bag with a person of normal body temperature), chemical heat packs, or insulated hot water bottles. Good areas to place these packs are the armpits, neck, chest, and groin. It is best to have the victim lying down when applying external re-warming. If the victim is alert and conscious, you may give a mildly hypothermic victim warm, sweet fluids by mouth, but avoid beverages containing alcohol or caffeine.

Preventing Cold-Related Disorders

Personal Protective Clothing

- Dress appropriately. Wear at least three layers: an outer layer to break the wind and allow some ventilation (like Gortex or nylon); a middle layer of wool, down, or synthetic pile to absorb sweat and retain insulating properties when wet; and an inner layer of cotton or synthetic weave to allow ventilation and escape of perspiration.
- Layer clothing to create air pockets that help retain body heat. Layering also makes adapting to changes in weather and level of physical exertion easier.
- Keep available a change of clothing, if work garments become wet.
- Pay special attention to protecting feet, hands, head, and face. Keep the head covered (up to 40% of body heat can be lost when the head is exposed). Fingers and hands lose their dexterity at temperatures below 59°F.
- Wear foot gear that protects against cold and dampness. Footgear should be insulated and fit comfortably when socks are layered.
- Avoid wearing dirty or greasy clothing because such garments have poor insulating properties.

Engineering Controls in the Workplace

- Use an on-site source of heat such as air jets, radiant heaters, or contact warm plates.
- Provide a heated shelter for workers who experience prolonged exposure to the equivalent wind-chill temperature of 20°F or less.
- Shield work areas from drafty or windy conditions.

- Use thermal insulating material on the handles of equipment when temperatures drop below 30°F. Do not sit or kneel on cold unprotected surfaces.

Safe Work Practices

- Educate new workers on the hazards of working in a cold environment.
- Allow individuals to set their own pace and take extra work breaks when needed.
- Avoid activities, whenever possible, that lead to heavy perspiration.
- Shift as many outdoor activities to the inside as feasible, and when working outside, select the warmest hours of the day.
- Minimize activities that reduce circulation, such as sitting or standing in a cold environment for prolonged periods of time.
- Keep energy levels up and prevent dehydration by consuming warm, sweet, caffeine-free, nonalcoholic drinks and soup.
- Allow a period of adjustment to the cold before embarking on a full work schedule.
- Avoid working alone in very cold weather; use a buddy system.
- Seek warm shelter immediately following these symptoms: heavy shivering, an uncomfortable sensation of coldness, severe fatigue, drowsiness, or euphoria.

Worker Health and Education

- Older workers, or those with certain medical problems, need to be extra alert about the effects of cold stress. Check with a doctor about special needs and precautions.
- Avoid using alcohol or drugs which may impair judgment while working in a cold environment. Hypothermia commonly occurs in association with alcohol abuse. In addition to its effects on judgment, alcohol increases heat loss through vasodilation and may impair shivering.
- Stay in good physical condition.
- Prevent chapped skin by the frequent application of protective lotions.

With proper preparation for working in a cold environment and learning the facts on cold exposure and following a few simple guidelines, deadly cold-related ailments can be avoided.